Using Collaborative Problem-Solving to Protect North Carolina's Coastal Resources: The Experience of the White Oak River Advisory Board*

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Introduction

In North Carolina coastal estuarine systems, land use change has been implicated as a significant cause of water quality impairment (NC Department of Environment and Natural Resources, 1997; White, et al., 1998). Such development processes change surface hydrology, pollutant delivery, and, as a consequence, adjacent water quality. Decisions regarding placement, density, and type of development are controlled by policy implementation at the local level. Furthermore, while the degree of impact may vary with each location, it is the cumulative effects throughout a watershed that can be most damaging to water quality. Hence, there is a need to develop and enact policy locally, but on a multi-jurisdictional, watershed basis.

Increasingly, local communities and governments are showing interest in playing a role in developing and implementing solutions to water quality problems (NC Department of Environment and Natural Resources, 1997). However, logistical complications arise upon implementation of this concept. First, a mechanism for effectively involving local citizen stakeholders in the policymaking process may not exist and/or is difficult to establish (Danielson, 1998). Second, technical data needed to address local issues and concerns are often not readily available, or are in a form not easily understood. Third, programs for addressing water quality problems on a watershed-basis may not exist, suggesting a need to develop, coordinate, and deliver multi-jurisdictional education on water quality issues and policy alternatives. Through a project entitled Watershed Education for Communities *and* Local *Officials (WECO)*, the North Carolina Cooperative Extension Service has worked with a number of state and federal agencies, along with citizens and local governments within a coastal watershed to address these needs.

The goal of this project is to improve water quality in all of the White Oak River Watershed through involvement and education of citizens and government officials who live and work in the watershed. The project's main thrusts are : 1) the delivery of technical information and educational material on water quality, management strategies, and policy options that support watershed-based planning; 2) the empowerment of local citizens by facilitating collaborative partnerships between communities, local officials, and state agencies within the watershed; and 3) the facilitation of the development

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of local stakeholder - driven policy recommendations for the entire watershed. This paper discusses the application of these concepts to an issue of critical importance to local citizens.

Background

The White Oak River watershed is one of four rivers in the White Oak River Basin (Figure 1). It is 48 miles long and encompasses 320 mi^2 . The watershed begins in freshwater creeks and swamps of Jones County, NC, and contains portions of three other counties--Craven, Onslow, and Carteret. Along its route to Bogue Sound and the Atlantic Ocean, the river traverses between 30 ft. banks, which are relics of ancient dune ridges. This river is home to five threatened or endangered organisms, including alligators; loggerhead, green, and leatherback turtles, and the Croatan crayfish. The river and its estuarine waters have extensive primary nursery waters and provide habitat for several anadromous species--herring, shad, striped bass, and sturgeon. The majority of the river is classified as SA, or saltwater suitable for commercial shellfish harvesting.

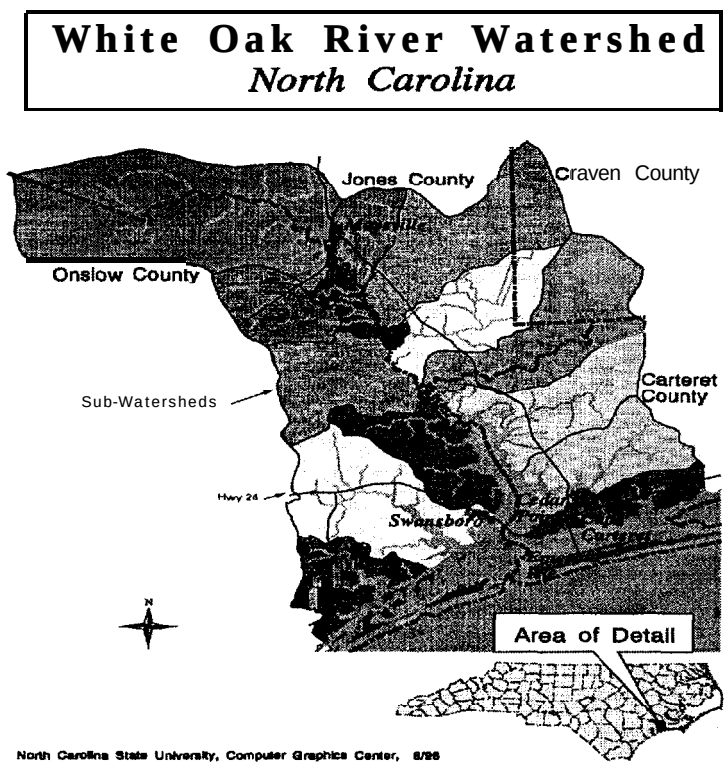

Figure 1. General map of White Oak River Watershed in North Carolina.

The White Oak River watershed has six major land cover/land use classes with wetlands encompassing the largest single type at 52% of the total. Forests are the second largest land cover type constituting the majority of the headwaters in the Croatan National and Hoffman State Forests (22%). A very small portion of the watershed is urban (2%) and agricultural (11%) (NC Department of Environment and Natural Resources, 1997).

Despite the low level of urbanization, the North Carolina Division of Water Quality's basinwide management plan notes an increase in shellfish closures in the river (North Carolina Division of Environmental and Natural Resources, 1997). At state-sponsored public meetings, over 100 citizens expressed concern and called for more public education on water quality.

Recognizing the interest of their constituencies in water quality education, local NC Cooperative Extension Service leaders assembled a project team involving members from the North Carolina Division of Water Quality, North Carolina Division of Coastal Management, North Carolina Division of Environmental Health - Shellfish Sanitation Branch, North Carolina Cooperative Extension, and 25 citizens who comprise the stakeholder-based Advisory Board for the White Oak River Watershed. This group includes crop farmers, livestock farmers, fisherpersons, developers, foresters, tourism directors, teachers, scientists, and local government officials from the watershed (see Table 1). The citizen advisory board is the decision-making entity. The government agency representatives and Cooperative Extension personnel function as support staff to the Board. Support staff provide resources, perform research and reviews, make reports, serve as technical advisors, and provide formal facilitation and consensus-building services.

The White Oak Advisory Board's Primary Issue of Concern

The Board began meeting in August of 1996. Their first task was to prioritize water quality issues upon which to focus their efforts, Board members expressed concern that past bridge and road construction across the mouth of the river had contributed to a decline in water quality. Furthermore, this road, Highway 24, was slated for expansion, and they were concerned that this would exacerbate the problems. The Board acknowledged the need for expansion of the road, but recognized a unique opportunity to mitigate its impact if they could move quickly to work with the North Carolina Department of Transportation (NC-DOT)

At the time that the Board was convened and identified the highway and its expansion as an issue, NC-DOT was in the process of conducting an Environmental Assessment of the project and were anticipating a Finding of No Significant Impact. During a meeting between the Extension Project Team and NC-DOT, DOT representatives were made aware of the Board's concerns and expressed an interest in working with the Board to address those concerns. However, timing was an issue because in several months, NC-DOT was planning right of way acquisition to begin the expansion project. Because of the urgency of the matter, the Board resolved to meet twice monthly and work to develop their comments and recommendations.

Technical Information Gathered by the Board

In response to the Board's inquiry, the Project Team reviewed, summarized, and presented scientificstudies that had been conducted on the river that related to sedimentation and flow patterns in the river and the possible effects of highway construction over the mouth of the river. Results from the following four studies were especially useful in understanding the science behind this policy issue.

Table 1. White Oak River Watershed Advisory Board – Stakeholder Composition.

Stakeholder Groups	Carteret	Jones	Onslow	At Large	Total
Fishing, Commercial	....				4
Fishing, Recreational			.		1
Real Estate or Development	.				1
Environment/ Conservation	.				1
Farming, Crop	.	.			2
Farming, Livestock			.		1
Forestry, Private			.		1
Business & Industry	.	..			3
Local Government	..	.			3
Academia/ Public Schools	..		..		4
Travel & Tourism					
NC Shellfish Sanitation				.	1
Soil & Water Cons.		.			1
Public Forestry				..	2
Totals	12	5	5	3	25

One study (Martens and Goldhaber, 1978) determined that the metabolic pathways by which bacteria degrades organic matter in the sediments differ depending on whether the overlying aquatic environment is salty or fresh. Chemistry analyses done on soil cores taken at various locations in the river found framboidal pyrite at upstream samples, which indicated that saltwater wedges had previously penetrated further upstream than current patterns in soil chemistry showed. These results provided evidence to the Board that saltwater flows in the river had changed over time.

Adams, Benniger, Hosier, Overton, and Reed (1982) studied water circulation and sedimentation patterns in the White Oak Estuary and found that sedimentation in the estuary varies from 0.3 cm/yr to 5 cm/yr. approximating the annual rate of submergence along the Atlantic coast. Their study confirmed for the Board that the system is a flood tide dominated system with sediment transport primarily occurring during storms with strong on-shore winds. The study also noted that the construction of the Intracoastal Waterway (ICWW) in 1930-32 in conjunction with the construction of Highway 24 in 1933 altered channel flow from one channel (adjacent to Huggins Island) to another (adjacent to the mainland near Highway 24). Spoil deposition from dredging operations may also be responsible for decreased channel flow in the west channel of the Inlet. The authors noted no evidence of a declining fishery based on the fact that it was comparable to other fisheries in the area and in line with historical production rates for the estuary. This study also quantified the extent of fill and alteration to the estuary caused by the original construction of the ICWW and the road in 1932 and 1933, respectively. Historical maps, when compared to current data, showed that two inlets were closed and that more than 80% of the river was obstructed by these projects.

Benniger and Martens (1983) investigated the age and the sources of organic matter in the estuary. This study characterized the organic matter degradation rates, which is important in understanding the estuary's capability to process organic inputs. The researchers determined that the upstream organic matter inputs were primarily terrestrial and the downstream organic inputs were primarily marine. However, they found that microbial processes acted preferentially to remove recently produced organic matter. This implies that recently produced or partially treated organic matter could substantially increase sediment oxygen demand and the rate of nutrient regeneration. This would increase the vulnerability of the estuaries to anoxia and algal blooms.

Kelley, Martens, and Chanton (1990), by collecting and analyzing sediment cores, characterized the relative remineralization rates of sedimentary carbon for the fresh and saltwater environments in the river. They found that the upstream environment, which is dominated by terrestrial inputs and the process of methane reduction, remineralized at a rate three times faster than the downstream site, which is dominated by marine inputs and uses sulfate reduction as the energy pathway for organic matter remineralization. As indicated in the previously described paper by Martens and Goldhaber (1978), saltwater circulation patterns, as well as freshwater inputs, appear to have changed such that the estuarine ecology has shifted towards a more freshwater system. Since freshwater facilitates rapid remineralization of organic carbons, this, over time, can reduce the river's buffering capacity and result in nutrient enrichment.

Initial Conclusions of Board

Based on these and other related studies, the Board concluded the following:

. Salt wedges that used to extend upstream have not occurred in recent history.

. Organic inputs upstream are from terrestrial sources and downstream are from marine sources.

. Salinity regimes in the river are highly variable seasonally and spatially.

. Salinity helps buffer the river from nutrient inputs.

. Sedimentation at the mouth of the estuary was considered normal for coastal estuary systems.

- There was no evidence to support a perceived decline in the fishery.

. Increased fresh water inputs from the expanded impervious surface area related to the highway expansion may have a negative impact.

- Higher salinity reduces concentrations of fecal coliform bacteria.
- Ditching and other means of moving water faster off the land causes problems with increased freshwater to the river as well as increased bacterial contamination in shellfish beds.
- There is a significant shellfish resource at the mouth of the river that has historically remained open.

Next, the Advisory Board convened a panel of specialists to discuss this information and potential mitigation strategies. The panel participants included:

- Dr. Larry K. Benninger, Geologist, University of North Carolina at Chapel Hill (UNC-CH);
- Archie Hankins, Biologist, NC-DOT;
- Tom Jarrett, Hydraulic Modeling, United States Army Corps of Engineers (USCOE);
- Dr. Chris Martens, Marine Sciences, UNC-CH;
- Dr. Paul Hosier, Biologist, UNC-CH;
- Dr. Rick Leuttich, Sedimentary Geologist, UNC-CH; and
- Howard Varnam, Hydrologist, USCOE.

The panel reviewed the scientific information presented to the Board, and they agreed that there has been an impact on the circulation and flushing of the White Oak River since the construction of the causeway and the ICWW, but quantification of those effects would require intensive modeling that would take a minimum of 1.5 to 2 years. The panel felt that any action to increase circulation and salt water inputs to the river would have an overall positive effect on water quality. However, the best manner in which to accomplish those goals and the particular effects on fisheries, sedimentation, or other water resource values would be difficult without modeling studies. The panel concluded that due to changes in land use, hydrology in the watershed had been altered. As a result, runoff volume during storm flows has increased. This increases pollutant loading and increases erosion processes during storms. The panel noted that a reduction in freshwater runoff would not have any significant effect on the diversity and density of species, but on their distribution. This would have little effect on flora and fauna in the river, but might improve water quality. The panel also noted that the most effective strategy for protecting water quality is to involve all of the communities impacting the system and to implement overall land use planning in the watershed. It was suggested that the group needed to define their water quality goals and how they want to manage the river and watershed to achieve those goals. Individual actions for localized effects would require some additional modeling and research to determine the best options.

The panel concluded with a list of mitigation recommendations listed below:

- Pursue a study of the river to determine what, if any, actions should be taken to improve circulation up and downstream of the highway.
- Examine options to manage stormwater in new and existing developments.
- Pursue the maintenance of buffers along creeks and streams.
- Pursue stricter enforcement of sediment and erosion control at construction sites.
- Endorse, encourage, and facilitate the use of BMPs in forests and farms.
- Work to develop a mechanism for watershed - based or coordinated land-use planning to address all of the suggestions.
- Explore alternative waste management strategies for both single users and municipalities to reduce nutrients.

The Board's Recommendations

Over the next several meetings, and as a consequence of these findings, the Board recommended the following actions;

1. To reduce freshwater inputs to the estuary and possible negative impacts of highway runoff on water quality, the Advisory Board recommended storm water runoff from bridge and highway expansion not be discharged into the river and that the Department of Transportation (DOT) explore options to eliminate discharge into the waterways. At a minimum, discharge from Highway 24 should be directed south (downstream) of the causeway to prevent impacts to shellfish. In addition, it was recommended that amelioration of the velocity, volume, and quality of that runoff be implemented, if feasible.

2. Historic maps showed that, prior to the 1930's, the mouth of the White Oak River was open and unrestricted, allowing free tidal flow. In 1932 and 1933, Department of Transportation and US Army Corps of Engineers (ACOE) projects closed approximately 80% of the mouth of the river and altered physical processes. The Advisory Board recommended that to restore salinity regimes, increase tidal circulation, and reduce sedimentation, DOT take actions to reopen the mouth of the river to the maximum extent possible. One option would be the creation of a north-south channel connecting the estuary with the sound near the current location of the Flying Bridge Restaurant on the Carteret County side of the river spanned by a bridge or connected by a culvert. Additionally, the Board recommended that DOT and ACOE access ACOE ecological restoration funds and collaborate with each other to mitigate the impacts of this expansion and past actions.

3. Since efforts to open the channel would not remain effective unless the State of North Carolina initiates an ongoing maintenance program, the Advisory Board recommended that a long-term maintenance program supporting improved circulation, reduced sedimentation, and restored salinity regimes be developed and implemented by responsible agencies.

These recommendations were presented to and adopted by commissioners for Carteret and Jones Counties in May and June of 1997. In addition, the White Oak River Watershed Advisory Commission of Onslow County (a group appointed by the Onslow County Board of Commissioners to address water quality issues in Onslow County) endorsed the recommendations of the Board at their May of 1997, meeting. This collaborative, consistent, watershed-based policy statement became part of the public record for the NC-DOT hearings in May of 1997, and a preliminary draft was included in the NC Division of Water Quality's Basinwide Water Quality Management Plan for the White Oak River Basin (North Carolina Division of Environmental and Natural Resources, 1997).

Response to the Recommendations of the Board

At a joint meeting that included representatives of the NC-DOT, the White Oak River Advisory Board, the Extension Project Team, and USCOE, the DOT agreed to support the Board's recommendations and revise their stormwater plans to direct runoff away from the shellfish resource in the river.

Blueprints for construction were redrawn reflecting the following features. In the vicinity of the bridges carrying Highway 24 over the White Oak River at Swansboro, NC-DOT agreed, to the extent possible, to direct the stormwater runoff from the roadway to the Bogue Sound side of Highway 24 and away from the river. In Swansboro (west of the island causeway), the existing stormwater collection system (which has outfalls on both the river and sound side of Highway 24) will continue to be used for the runoff following roadway expansion, thus preventing the need for additional outfalls in the river.

From the island causeway eastward for approximately 2.5 miles, the stormwater runoff from the highway will be collected and piped to outfalls on the sound side of Highway 24. Also, NC-DOT has designed special channelization islands for commercial driveways to accommodate some of the stormwater runoff from the highway and bridges. These water quality islands are depressed inside the curb to allow the first inch of highway runoff to pond within these islands and filter through the grassed areas located there. The filtered runoff from these islands is then collected and piped to outfalls on the sound side of Highway 24.

In addition to the stormwater design changes, it was agreed that DOT would cooperate with other state and federal agencies in any efforts to improve circulation and tidal flushing. Currently, the Board is continuing to work on adding a section to the Congressional *Water Resources* Development *Act* that would authorize the USCOE to conduct the study necessary to determine what, if any, actions could be taken to improve flushing in the river.

Conclusions

Local stakeholder-based citizen groups can impact policies that affect their environment. Support for gathering, summarizing, and delivering technical information to local citizens and governments is an important aspect of the success of these processes. Knowing who to approach for answers to specific questions, and where to look for scientific information is an important function of the group's technical support. In addition, translating the information gathered into digestible and usable material is also critical.

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